

Riparian Health Assessment Summary

Monitoring Year 2020-21: Poor monsoon exacerbates drought conditions in the Cienega Creek watershed

Cienega Creek is one of the few remaining perennial lowland streams in the region. Cienega Creek and Davidson Canyon are stunning examples of what many riverbeds could look like if similar preservation efforts are employed. These shallow groundwater-dependent systems and Outstanding Arizona Waters (OAW) support wildlife habitat and human activity alike. Cienega Creek and Davidson Canyon are among the 18 priority waterbodies identified in PAG's 208 Plan for monitoring and protection. However, declining flows observed over the past two decades provide a reminder of the ecosystem's vulnerability to declining water tables and drought.

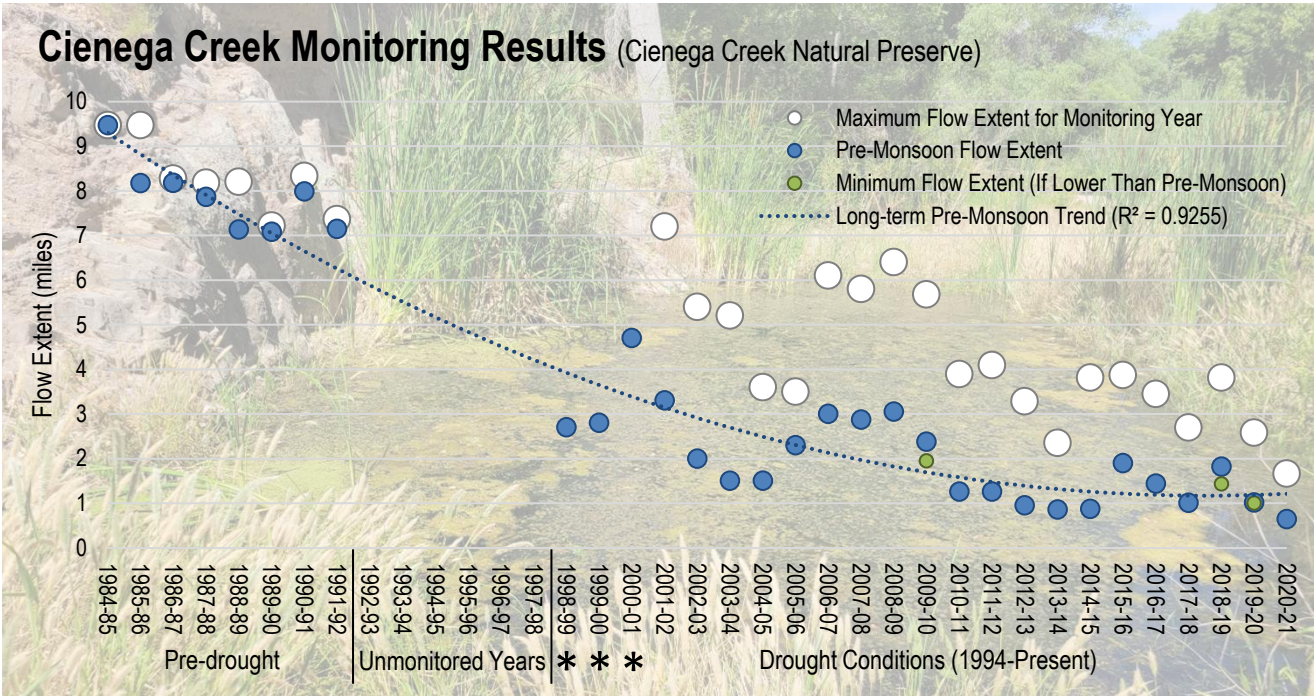
PAG has monitored hydrologic conditions in Pima County's Cienega Creek Natural Preserve (CCNP) since 1989. The CCNP is in the lower part of the Cienega Creek Watershed. Every quarter, PAG maps baseflow in the reaches of Cienega Creek and Davidson Canyon that fall within the CCNP. The charts display the time of year that is usually driest (May/June) to reflect the minimal perennial (year-round) extent of surface water. The annual maximum flow extents reflect the greater aquatic habitat present in wetter seasons.

Pre-Monsoon Flows

In monitoring year (MY) 2020-21 (July 2020 – June 2021), PAG observed record low flows all four quarters, with June flows along 7% of the 9.5-mile monitoring extent. As shown on the linear comparison chart on page 2, decreased flows were observed in all creek reaches. While two isolated pools were observed in the area, the reach farthest upstream held no June flow for the first time since PAG resumed monitoring in 1999. Perennial flows were not observed in lower Davidson Canyon, near its confluence with Cienega Creek.

Davidson Canyon was dry upstream of Interstate 10 (I-10) all four quarters. This was the first monitoring year in which upper Davidson Canyon was dry on all monitoring dates. Flow extents in upper Davidson Canyon are highlighted on page 3.

Record low flows in the CCNP were likely due in part to an abnormally dry monsoon season in 2020. Rainfall trends in the Cienega watershed are further explored on page 4.

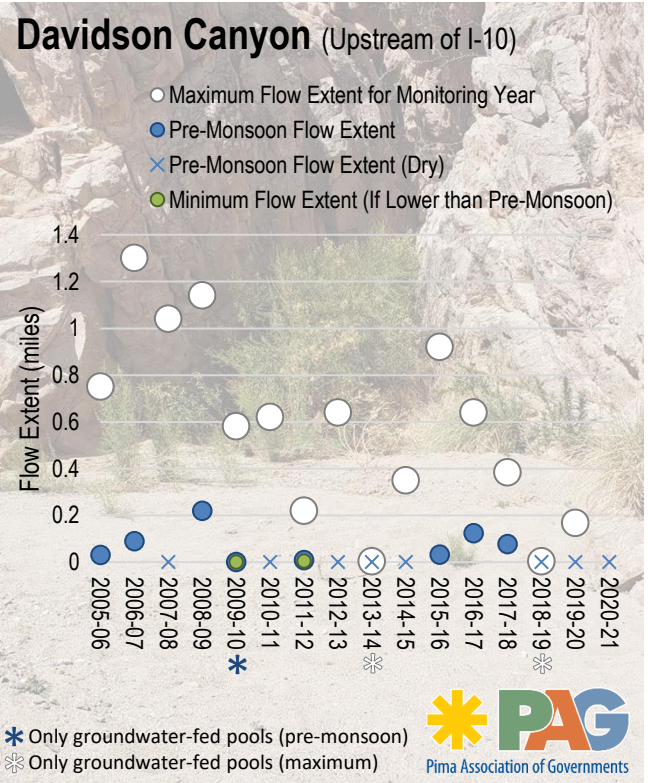


Protecting Priority Waterbodies

PAG's updated 208 Plan was approved by the U.S. Environmental Protection Agency in June 2021. The plan identifies 18 priority waterbodies (listed below) for water quality and quantity monitoring, management and restoration. It is PAG 208 policy that "issuance of AZPDES permits for commercial, industrial, or domestic wastewater facility discharges to the priority waterbodies would be inconsistent with the 208 Plan. Future 208 Plan Amendment applications that would allow such discharges are discouraged but not prohibited if consistent with state surface water quality standards. However, efforts to restore floodplain aquifers or reestablish flow or degraded riparian vegetation would require special consideration to determine if there are net biological benefits." The 208 Plan is available at pagregion.com/sustainability/water-quality/208-plan/

- | | |
|---------------------------------|---------------------------------|
| Agua Caliente Canyon | Espiritu Canyon |
| Agua Verde Creek | Florida Canyon |
| Arivaca Creek | Mattie Canyon |
| Bingham Cienega | Quitobaquito Spring |
| Buehman Canyon | Rincon Creek |
| Cañada del Oro (upper) | Sabino Canyon (upper and lower) |
| Cienega Creek (upper and lower) | San Pedro River |
| Davidson Canyon | Tanque Verde Creek (upper) |
| Empire Gulch | Wakefield Canyon/Nogales Spring |

* Only pre-monsoon data available for these monitoring years



* Only groundwater-fed pools (pre-monsoon)
* Only groundwater-fed pools (maximum)



Cienega Creek

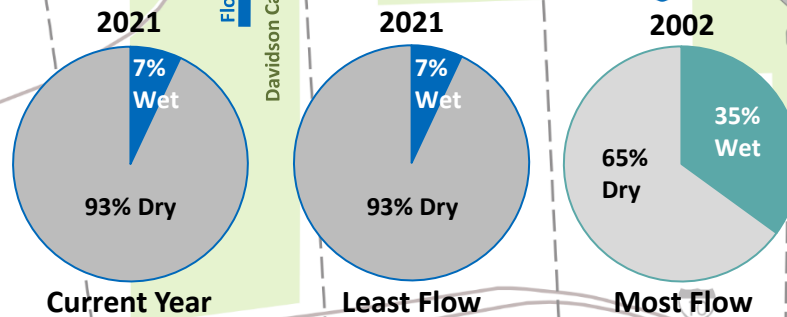
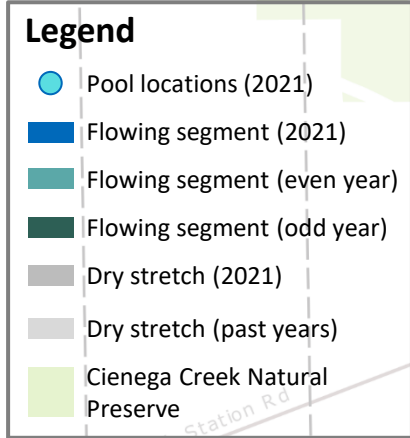
Pre-Monsoon Flow Extent 2002 to 2021

The chart below displays changes in June pre-monsoon baseflows for Cienega Creek within the CCNP since 2002. Baseflows are groundwater-based creek flows, without the influence of recent stormwater runoff. As the creek's flow extent decreases due to sedimentation, drought and/or groundwater pumping, the increasingly segmented flows are limited to reaches where shallow bedrock layers keep the water table close to the surface. Wetter years elevate the water table, allowing segments to connect and flow to a greater extent.

Results from 2021 are shown on the map. The map displays eight of the 9.5 miles of Cienega Creek that are monitored quarterly, plus part of lower Davidson Canyon. Perennial flow has not been observed in the upper 1.5-miles of Cienega Creek in recent years. The bar chart shows conditions from previous years, translated to-scale into linear bars, allowing easy comparison of flow length and location from year to year. Colors alternate for visual aid. The pie charts were generated based on pre-monsoon flow extents in the full 9.5-mile monitoring area, which includes a small portion of lower Davidson Canyon (not included in the linear chart).

PAG has consistently monitored flow extents within the Cienega Creek Preserve since 1989, as is necessary to provide reliable trend analysis. Results are reported to the Arizona Department of Water Resources for compilation into state records.

PAG's annual riparian health assessment reports and resources are available here:
<https://gismaps.pagnet.org/PAGLibrary/>



Upper Davidson Canyon

Pre-Monsoon & Quarterly Flow Extents

2005 to 2021

Legend

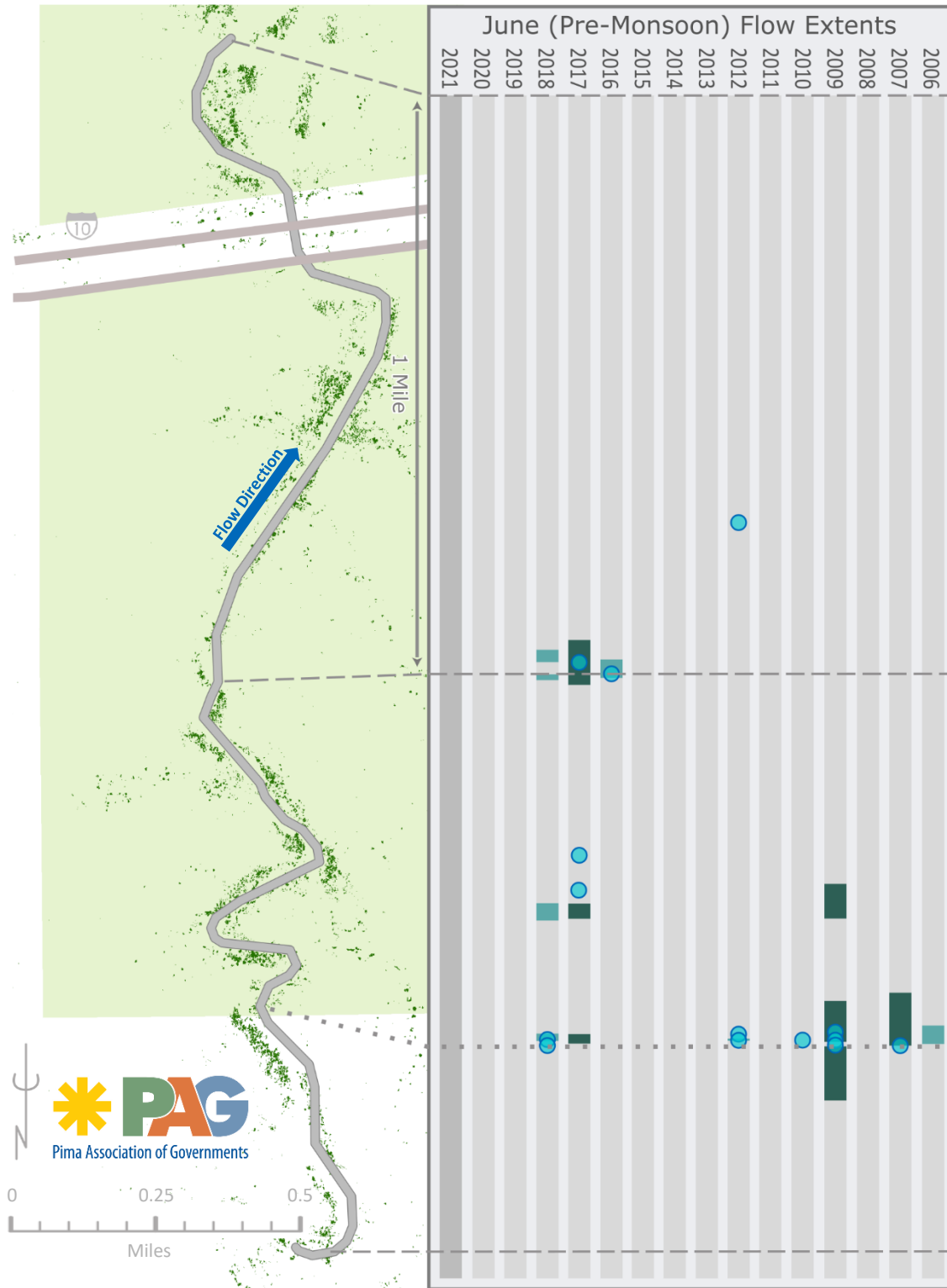
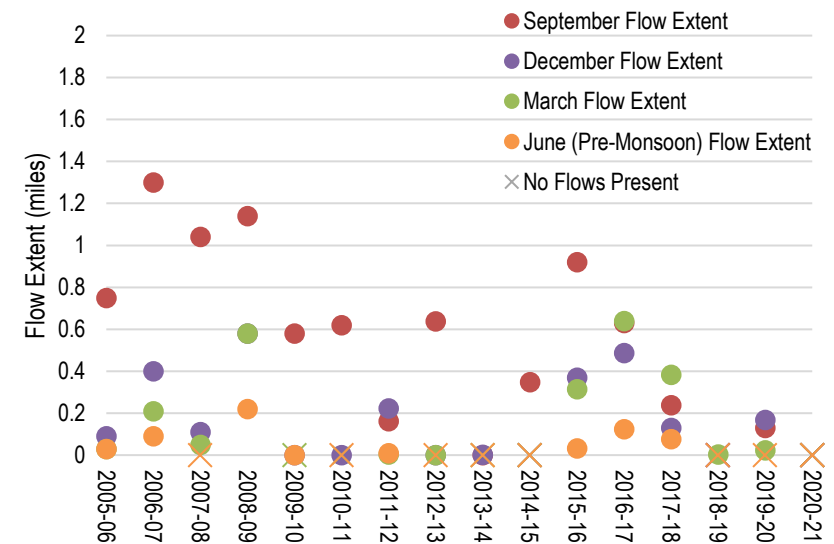
- Pool locations
- Flowing segment (2021)
- Flowing segment (even year)
- Flowing segment (odd year)
- Dry stretch (2021)
- Dry stretch (past years)
- Tree Canopy (2015)
- Mile Indicator
- Davidson OAW Upstream Limit
- Cienega Creek Natural Preserve, plus Bar V Ranch

The chart at left displays changes in June pre-monsoon baseflows for Davidson Canyon within the CCNP since 2006. Results from 2021 are shown on the map. The map displays just over two miles of upper Davidson Canyon, where intermittent flows have been observed since 2006. Tree canopy data and regular riparian health assessment data show that the riparian vegetation in Davidson Canyon has persisted over time, supported by shallow groundwater.

The graph below shows quarterly flow observations measured in September, December, March and June of each monitoring year. Flow extents include the total length of flow and isolated pools that are not adjacent to flow within this stretch of Davidson Canyon.

Davidson Canyon Quarterly Flow Extents

(Upstream of I-10)

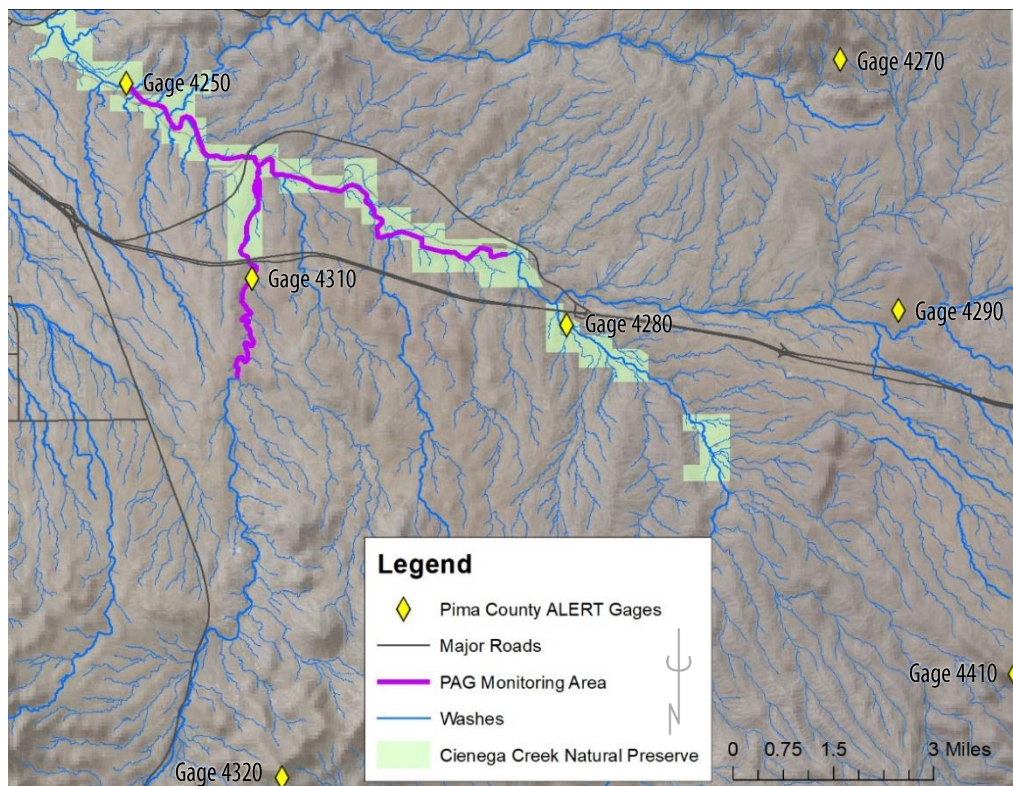


Rainfall Trends and Creek Flows in the Cienega Watershed

The graphs to the right show average monsoon, winter and total rainfall trends versus quarterly flow extents in Cienega Creek and upper Davidson Canyon. Average rainfall was calculated using historical rainfall data available from the Pima County Regional Flood Control District's Automated Local Evaluation in Real Time (ALERT) database. Rainfall totals were averaged from seven precipitation gages in the Cienega watershed (numbers 4250, 4270, 4280, 4290, 4310, 4320, and 4410). Gage locations are shown on the map below, along with washes that drain to Cienega Creek and Davidson Canyon. Rainfall averages were calculated for the following time periods within each monitoring year: monsoon (June 15 – Sept. 30), winter (Dec. 1 – Feb. 28/29) and monitoring year (July 1 – June 30). While the monitoring year runs from July 1 to June 30, June 15 was used for monsoon totals, as the monsoon season officially begins on June 15.

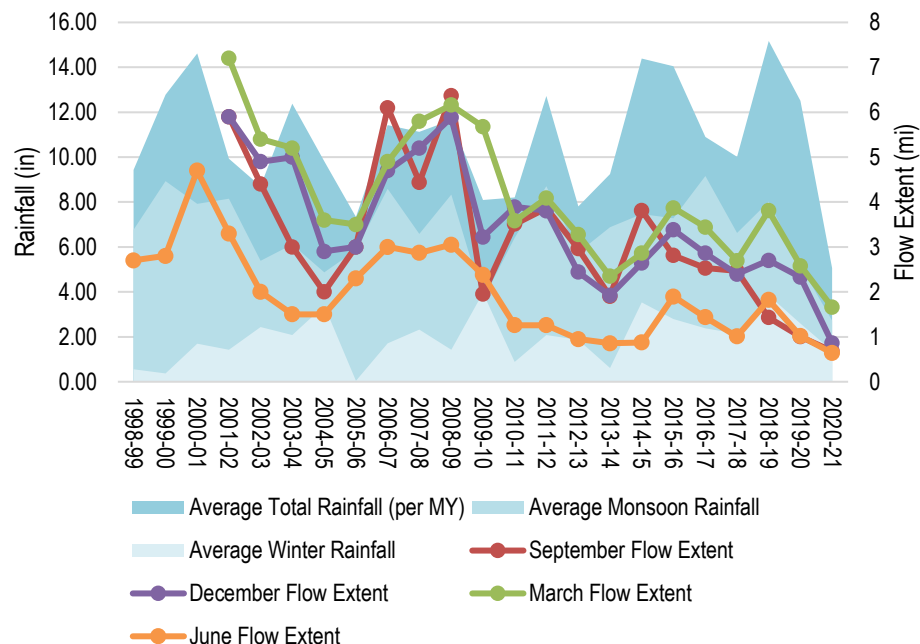
Since 1998, flow extents have trended downward in Cienega Creek across all quarters, while rainfall has fluctuated from year to year. Flow extents in upper Davidson Canyon reflect a similar trend since 2005. Southern Arizona has experienced drought since the mid-1990s. These data suggest that precipitation and resulting groundwater recharge has not been sufficient during the drought to balance out both natural and human demands on the shallow groundwater that feeds this system. As drought conditions and groundwater pumping continue, flows will likely continue to decline.

Rain Gages and Natural Drainages in the Cienega Watershed



Average Rainfall vs. Cienega Creek Flow Extents

(Cienega Creek Natural Preserve)



Average Rainfall vs. Upper Davidson Canyon Flow Extents

(Upstream of I-10)

